This Week: What to Make for July 4th

POPULAR MECHANICS

An Illustrated Weekly Review of the Mechanical Press of the World

TELLS YOU HOW TO DO THINGS. WRITTEN SO YOU CAN UNDERSTAND IT.

Vol. 1. No. 25. CHICAGO, JUNE 28, 1902. PRICE 5 CENTS.

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Greatest Invention of the Century

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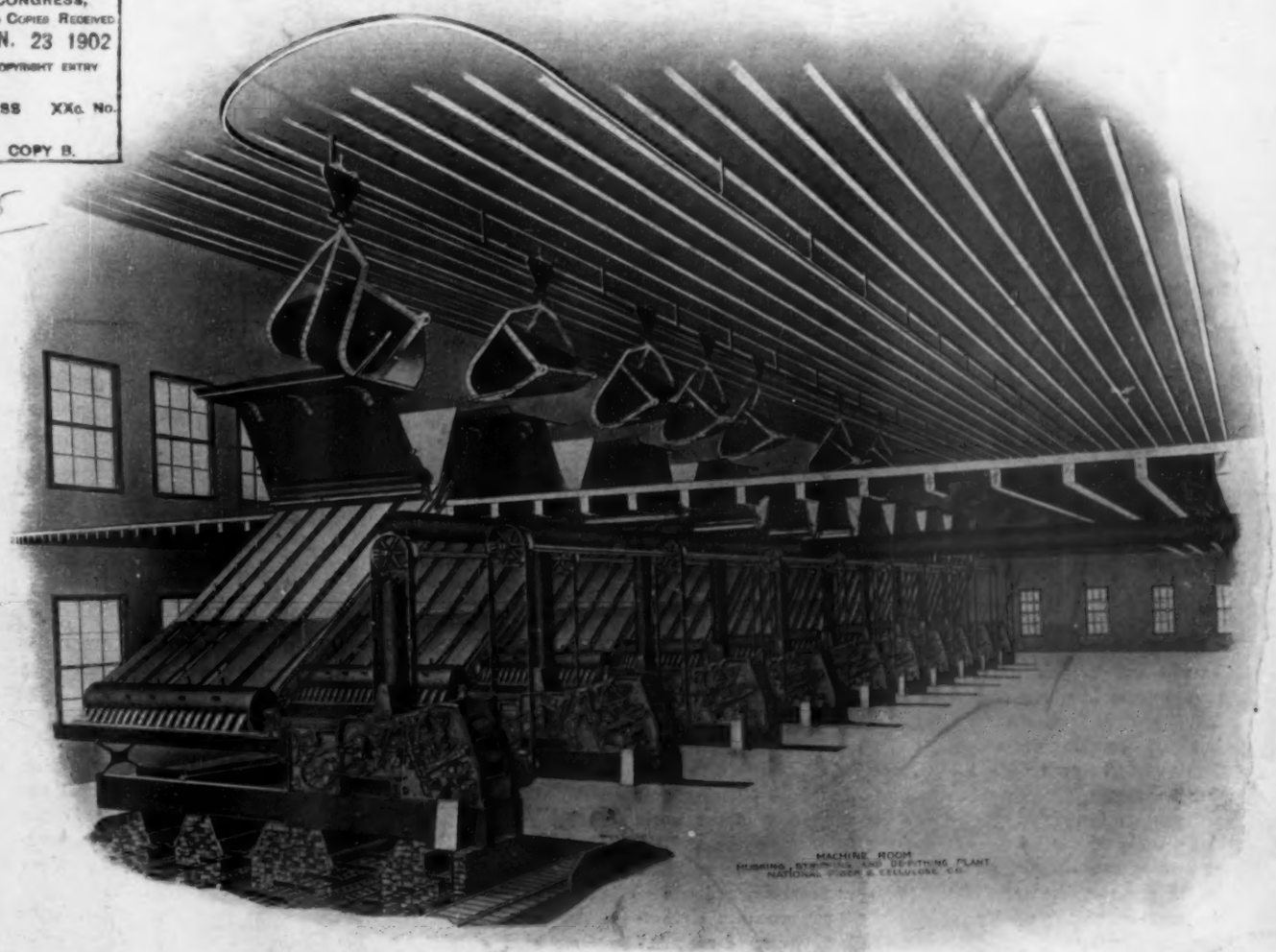

MACHINE ROOM
HUMMING, STRETCHING AND DE-FITTING PLANT
NATIONAL FIBER & CELLULOSE CO.

This Machine Makes Corn Stalks Worth Millions

SUMMER COURSE IN EASY MECHANICS, FOR BOYS

Begins in This Issue

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PULP FOR PAPER MADE FROM CORN STALK.

A Chicagoan After Years of Labor, Perfects the Greatest Invention of the Century.

No longer is the United States dependent upon Canada for its supply of pulp for paper and paper is a commodity which enters more conspicuously into the life of every American citizen than any other, excepting food and clothing. No longer is there cause for alarm over the growing scarcity of the Canadian spruce, from which our paper is made. No longer need publishers and the public fear that the one cent daily and other cheap publications will soon become an impossibility, because of the extinction of the Canadian forests. The millions of dollars Uncle Sam has been paying Canada for wood pulp from which our newspapers, books, writing paper, wrapping paper, and every other kind of paper is produced, may now remain at home. This money will go to the American farmer—the corn grower—and he will find his profits trebled, or perhaps quadrupled.

A process has been discovered by which paper of all grades may be made from the corn stalk. For many years the world has been searching for a material of annual growth from which paper could be produced. It remained for a Chicagoan to make the discovery. Quietly this Chicagoan has been laboring over the process for eight years. Now he announces to the world the success of his labors and has the pulp, the paper and the process of manufacture ready to exhibit. His may be regarded as the greatest discovery of the twientieth century, and one of the greatest of the world. It makes a new epoch in civilization, another step in the evolution of the "keeping of records."

At first these records were kept by repeating them orally from father to son, next by the carving of characters on stone, as revealed in ancient ruins; following these Egyptian hieroglyphics came the writing on papyrus, an Egyptian reed; parchment, the next material in order, was invented by Eumenes, king of Pergamus and perpetuated his name in history; at this time, the outer world discovered that the Chinese had long been making a crude paper from the inner bark of the mulberry tree, the next step in the advancement was made by Spain which produced paper from woolen and cotton rags; then flax, hemp and linen rags gained first place in the popular favor.

The manufacture of paper attained its first degree in Spain and then spread into Italy, France and Burgundy; later into Germany and the Netherlands, reaching England in 1588, the first fine white paper being made there in 1690. The art saw its inception in America in 1690, a factory being established near Philadelphia by William Rittenhouse. Here paper was made from refuse, such as rags, waste paper, old sacks, ropes, etc.

The next great step in the evolution was made by Dr. Hill of Augusta, Maine, who discovered the process of making paper from wood, the process that has since been in vogue. The idea was suggested to Dr. Hill by a hornets nest. "If a hornet can make paper from wood," he argued, "why can't man do the same." He discovered that the hornet first chewed the wood into fine pulp before making it into nest material. Such was the beginning of the wood pulp industry, which has since been one of the greatest sources of wealth.

But the trees from which the wood is obtained grow slowly; many years are required for them to attain maturity. Thousands of trees are consumed in the manufacture of paper necessary to produce one day's supply for America. The forests are being bared. Few of the trees remain.

But "necessity is the mother of invention," and as these once great paper producing forests seem upon the eve of extinction, an American has come to the rescue with a new material and source of supply, even as King Eumenes did hundreds of years ago. Thus the "keeping of records" goes on and now the newspapers may publish the almost hourly records of the happenings of the world, at less expense than before.

And who is this American who has been such a benefactor of mankind? He is a modest Chicagoan, who lays no particular claim to fame and who refuses to announce his invention as anything out of the ordinary. His name is George R. Sherwood. His greatest delight seems to be in knowing that he has succeeded in aiding the corn grower to make largely increased profits from his corn crops.

Not only has he succeeded in making paper from the corn stalk, but in utilizing every particle of the corn plant to mercantile advantage. It used to be that the cotton seeds were regarded as waste and one of the greatest labors and expenses of the cotton planter was to get rid of them. These seeds are now almost as valuable to him as the cotton itself. Far greater will

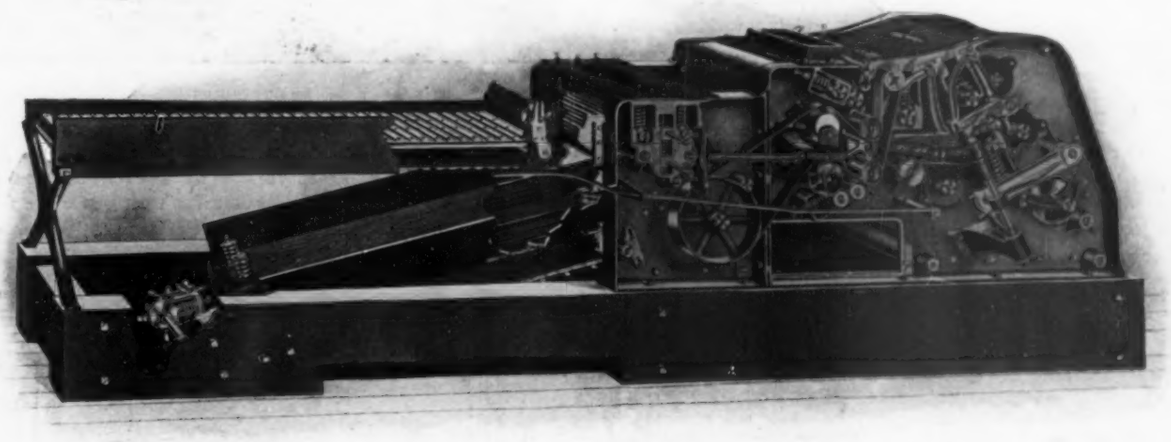
STATES	TONS
Ohio	4,489,387
Indiana	6,434,433
Illinois	11,095,401
Iowa	12,846,117
Missouri	7,589,836
Nebraska	8,838,062
Kansas	6,882,566
Total waste	58,175,802

These figures show what was produced and wasted; which waste was available for feed, paper stock and cellulose compounds.

Map Showing Corn Belt and Corn Crop, 1900.

be the advantage of this new invention to the corn grower. No longer will it be necessary to gather and husk corn and pull fodder by hand. The corn plant in its entirity is fed to a single machine and this machine separates the ears, husks, leaves, shell and pith, preparing each product for its respective market. The fine inner husks are sold for manufacturing mattresses and upholstery. The pith of the stalk is used for making certain grades of paper, paper box boards, cellulose, gun cotton, smokeless powder, varnish and many other products. This pith mixed with waste leather makes a floor covering superior to any grade on the market; also wall decorations and paneling capable of being embossed and finished in a highly artistic manner and at moderate cost. From the hard shell of the corn stalk is made the pulp that is destined to replace that produced from the Canadian wood. While all this process of separation is accomplished with one machine operated by one man, it is purposed for the average depithing plant to consist of 5 or more machines, with automatic conveyors for transferring the materials from the farmer's wagon to the depithing machines or the stacking yards, and sufficient engine and boiler capacity to operate the machinery, all of which will be housed in substantial buildings.

The de-pithing machine will, when stalks are fed to it, snap off the ears and drop them on the husking rolls, the stalks passing on into the machine. The husking rolls husk the ears, delivering them to a conveyor, and the husks which cling to the ear when it is snapped from the stalks will be drawn off by another conveyor. The husked ears of corn the farmer may remove to his crib or deliver to his merchant, or the company will be prepared to purchase it from him at the market price, or store it for him, whichever he may desire. As the stalk passes on through the machine such of the husks as adhere to the stalk, together with the leaves on the stalk, are next stripped off and likewise drawn from the machine by a conveyor. Thus stripped of the ears, husks, leaves and dirt, the clean stalk next passes into the de-pithing section of the machine, where the shell and the pith are separated and deposited on separate conveyors ready for the paper mill and other mills where they will each be worked into a finished product.



Machine for Husking, Stripping and De-Pithing the Indian Corn Plant.

A company has been organized for the purpose of exploiting this marvelous invention of Mr. Sherwood. It is known as the National Fiber and Cellulose Company, and has offices at 1001 Merchant's Loan and Trust building, Chicago.

To comprehend the wonderful saving and profits that will result from this new invention one must realize that the United States produces the corn used by the civilized world. More than 80,000,000 acres of ground are devoted to corn each year. Of this enormous crop one-half has heretofore been an absolute waste. The accompanying map of the corn belt will give an idea as to the enormous extent of this former waste, all of which may now be utilized and turned into money for the farmer. The whole of the corn plant, less the ear, is called stover.

Only a short time ago Popular Mechanics said:

"Something must be found besides spruce and white pine wood pulp from which cheap paper can be manufactured. These sources of supply are so rapidly becoming exhausted as to threaten the existence of the one-cent daily newspaper and other large consumers."

The Southern Industrial Review said: "A material which nature may renew yearly must be discovered and adapted to the trade and the most natural sources must be sought in the field of agriculture or among the fibres and grasses which have annual growth."

The Boston Herald a month ago said: "The paper making industry of the world will soon be dependent on Canada for its raw material. The great pulp wood reserves of United States, Norway and Sweden are already becoming exhausted and there is actually no place in the world excepting Canada for the bulk of its spruce supply.

The Fourth Estate said: "Canada is to be the greatest producer of wood pulp and paper in the world, not in the distant future only but in the days that are now at hand."

With Canada supplying the paper of the world, it is not hard to prophesy how long it will be before her already thinned spruce forests will become extinct. The paper made from the corn stalk pulp is far superior in quality, and can be made much cheaper than it can be made from wood pulp.

AMERICAN WOMEN LIKE ANGELS.

Prof. Weihrle, of Berlin, an eminent German teacher of esthetics, has this to say of the American woman:

"The American climate is one of the chief causes of her preeminence. Her graceful lightness, an ease of bearing entirely her own, her quick, mercurial movements, her fascinating, beautiful head, her tender roundness of limbs, are seen only in America.

"These are the women that resemble one's conception of what fairies, sylphs, nymphs and angels ought to be. Beauties such as Rubens painted are seldom met with among the Americans of the Anglo-Saxin race, but beings such as Raphael painted are frequently seen in the streets of every large city."

Popular Mechanics

Published by Popular Mechanics Co.
Journal Building, - - - Chicago

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year.....$2 00
Foreign Countries, post paid..... 3 00
Monthly Edition..... 1 00
Advertising rates, $2 per column inch per issue.

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POPULAR MECHANICS
Journal Building, - - Chicago

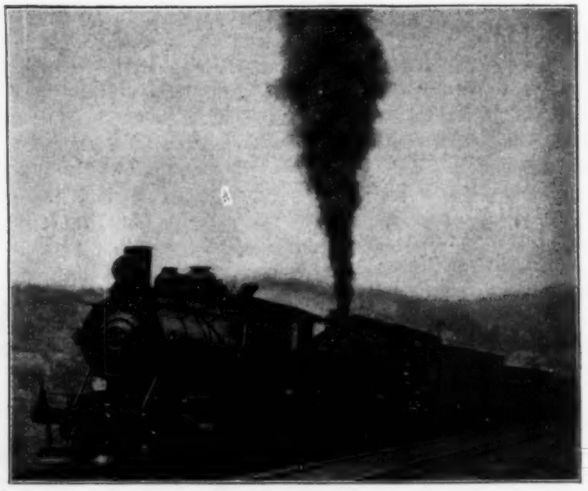
Entered at the Chicago Postoffice as Mail Matter of Second Class.

NEW GERMAN ACETYLENE GENERATOR.

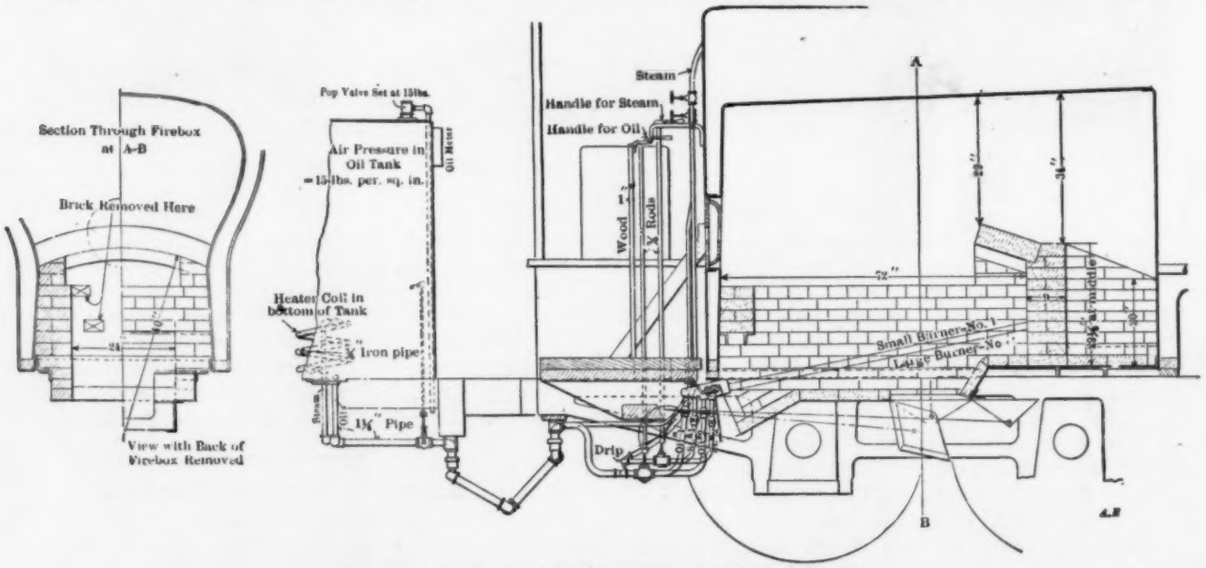
Consul-General O. J. D. Hughes, of Coburg, reports that Mr. Erik Cornelius, chemist at the carbide factory at Trollhattan, has invented a new acetylene generator. This generator is described as being much simpler in construction than any yet placed upon the market, and occupies but little space. In its operation, the falling of the carbide into the water is automatically regulated by a hollow rubber ball, which, as soon as it is filled with gas, closes the valve between the carbide and the water. When the volume of gas decreases, the rubber ball contracts and the feed valve again permits the carbide to drop. The gas is stored partly in the rubber ball and partly in the space between the funnel-shaped carbide magazine and the water. If more than the normal amount of gas is generated, it secures more room by forcing the water through valves into the water jacket in the sides of the apparatus. A separate gas tank is therefore not needed. Should too much gas be produced, both the water and the gas escape through a safety valve. Common carbide is used; no cartridges. The gas is dried by being allowed to pass through the carbide magazine, where the carbide absorbs the moisture. As there is no gas tank, and as the quantity of gas thus stored is insignificant, it is considered that the fire insurance companies will, without raising the premiums, approve of the apparatus, even when it is placed in dwelling houses.

BURN OIL TO STOP SMOKE IN TUNNEL.

Railroad men working on freight trains dread the passage through the Hoosac tunnel. The tunnel is 4¾ miles long and the track rises from each mouth towards the center making over two miles of heavy grade going either east or west. Even the fast moving passenger trains travel in a cloud of smoke and gas, while the freights fare much worse. An attempt has been made to remove the smoke through an air shaft 1,028 feet to the top of the mountain, with an immense fan to increase the draft. This helped but did not cure. Now the company have fitted some engines to burn oil which makes no smoke and little gas.



Head Engine Burns Oil.



Firebox Setting for Oil Fuel—Boston & Maine Railroad.

Our illustration from the American Engineer shows a train on the up grade nearing the tunnel. The helper engine, burning oil, is in the lead, and working just as hard as the second, which burns coal. The cut shows the difference in smoke production. The oil is carried in an iron tank on the tender and forced into the burners under an air pressure of 15 pounds per square inch. The cut of the firebox shows the details.

Popular Mechanics is "written so you can understand it."

Things to Do and Make for July 4th

NEW AND BRILLIANT CONCEITS IN FIREWORKS.

Miniature Volcanoes and Hundreds of Other Designs Invented by Americans.

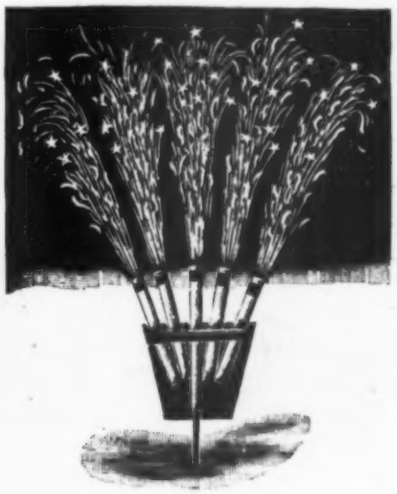
It used to be that China was the only nation that knew how to manufacture fireworks. Now American inventive genius is making China look to its laurels. Many new and beautiful conceits in the line of explosives are on the market this year—the product of American manufacturers—that will make even the Chinamen look on in amazement. The old time fire-cracker and roman candle still hold sway but they are eclipsed in grandeur by some of these new inventions. There are all kinds of mines, batteries, floral shells,saucissions, Jacks-in-the-box, devils-among, the-tailors, wheels, verticals, triangles, rosettes, geysers, prismatic whirlwinds, etc., that will be a delight to the youthful celebrator. There will be volcanoes that will give a miniature representation of Mount Pelee in eruption. Some of the most beautiful effects are obtained from the Bengola lights, colored torches, new flower

"What Happened to Hooligan".

pots, gerbs, etc. More brilliant still are the new silver birch trees, aerolites, fountains, Indian jugglery, fiery meteors and bouquets of rockets.

For lawn displays the fan fountain commends itself as a thing of beauty. It produces a brilliant outburst of scintillating fire in such a manner as to show a grand fountain of fire spreading out like a fan. What happened to Hooligan will amuse every boy and girl that can possess one of these novelties. When the stem to Holligan's rocket is lighted he has more terriffic experiences than ever related by the comic supplements. Then there is the house that Jack built, cheap and entertaining as can be The chimney of the house is a big fire cracker. The boy builds the house, puts in the chimney cracker with fuse end up. When lighted it explodes the cracker and blows the house to atoms. The house and crackers can be bought for about $1 a hundred. Montgolfier balloons, which when flying high look like a strange star in the sky, are made in more brillant designs than ever this year. Meteoric balloons are also to be in great demand. The string of fireworks attached to the tail is lighted when the balloon ascends. As soon as it gets above the house tops the display commences and lasts until the baloon is high in the heavens, discharging all the time a continuous stream of meteors, bombs, gold rain, etc., and making a brilliant aerial display for public and private exhibitions. There are hundreds of other designs in fire works, many of which are very expensive and many are in the reach of all.

A handsome lawn decoration is known as the "decorating net."



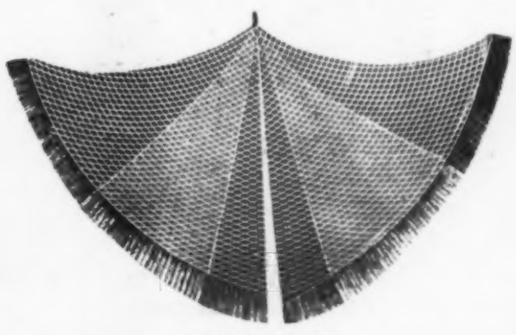
Fan Fountain.

It is a new novelty made of cambric, in American, French, Irish, Italian, Foresters and Knights of Pythias colors. The nets are durable and can be festooned in forms of butterflies, fans, etc. When spread out they are about 40 by 90 inches. They may be bought for $5 a dozen.

DIRECTIONS FOR FIRING FIREWORKS.

Rules Every Boy Should Know About New Explosives and the Old Ones.

Many kinds of fireworks will appear this Fourth of July, which the youthful celebrator has never seen before. They will be told about elsewhere in this issue. Below are directions



Decorating Net.

furnished Popular Mechanics by the Paine Manufacturing Company, the largest manufacturers of all kinds of fire works in the world, which tell how these new inventions, as well as the standard fireworks should be handled:

When possible, fire from level ground. Avoid firing from a platform, it is dangerous and liable to cause accidents. The

person in charge of a display should be cool-headed and careful. The fireworks exhibition pieces, when possible should be placed in position before dark, and loose goods, such as shells, batteries, etc., placed at a safe distance in the rear, and kept covered with canvass or rubber cloth, so that no sparks may fall upon them. Sky rockets should have the sticks attached, and covered as above.

Roman candles may be fired from the hand. Grasp around the candle firmly an inch or so from the end that has no fuse. Hold steady and firmly, but do not shake.

Sky rockets are fired from troughs, which should be placed

METEORIC BALLOONS.

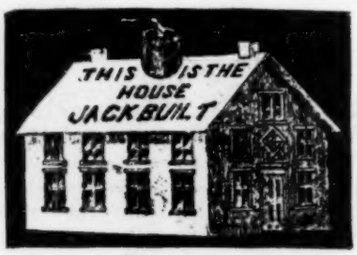
MONTGOLFIER BALLOONS.

on the ground. Do not fire rockets from a platform. Troughs may be made of two boards, five or six inches wide, and longer than the longest rocket to be used. Brace upright with a slight angle, so as to prevent the rocket from falling over. Light the black fuse and step back a little. Be sure and keep loose rockets far enough away from the troughs so that no falling sparks may ignite them. Keep them well covered.

Jack-in-the-box, mines, batteries, floral shells, saucissons, devil-among-the-tailors.—Place on level ground, remove outside covers and light fuse.

Wheels of all kinds, verticals, triangles, rosettes, etc.—are fired from posts. Each wheel is provided with a spindle or wire nail, which is to be put through the hole in centre of wheel and driven in the post near the top. See that the wheel revolves freely and does not touch the post. Light fuse and step to one side.

Geysers and prismatic whirlwinds.—Place on smooth ground



This Will be Popular.

or a level board, the stick or cross-guide down with its ends turned up. Light black fuse and step a little away.

Bengola lights, colored torches, flower pots, gerbs, etc.—Those with handles to be held by the handle; without handles may be stood upon the ground.

Silver birch trees, aerolites, fountains, Indian jugglery, fiery meteors and Mount Vesuvius;—are fancy ground pieces with pointed ends. Plant firmly in the ground and light fuse.

Balloons.—Select a place sheltered from the wind as much as possible. Open the balloon and have the sides held out by three or four persons, the mouth of the balloon being about a foot from the ground. Light the inflator, and when a sufficient strain is felt, allow the balloon to rise. In the case of the fireworks balloon, attach the trail of fireworks to the hanging wire, and light the trail before letting go the balloon.

Bouquet of rockets,—should be set up on end, nearly perpendicular and well braced. Open the end and light at fuse.

Shells of all kinds;—are fired from mortar and must be handled with extra care. The mortars should be placed upright in the ground (in some open space), about two-thirds being buried. The shell is put in the mortar, cone end down, leaving fuse hanging over the outside of the mortar. Light the black end of the fuse and quickly move away a good distance. Never lean over the muzzle of the mortar when placing shell in, or after shell is in. Always clean the mortar of all paper and fire after each shell is fired.

Exhibition pieces—are put on posts 2 by 4 inch stuff, 12 to 16 feet high, with cross braces on the bottom to hold them steady, and stood on level ground. These standards or posts can be tipped over so as to put on the pieces without a ladder. Nail the hanger on the side of the post (according to the size of the piece) near the top of post. In order to allow all the people to easily witness the display, the bottom of the frame of the piece should not be less than six to ten feet above ground.

FIRE CRACKER KITE.

The sport is better adapted to engage in at a lake or over a river or pond, than in towns and cities. It may, however, be safely indulged in if the kite can be flown over a large vacant lot or prairie. To the tail of a good-sized kite fasten a bunch of fire crackers. To this tie two feet of string and fasten another bunch. If the kite is large and the wind strong, several bunches may be hung one below the other. Around the string connecting the bunches of crackers wind tissue paper, in which is laid a grain of powder. Tie the tissue paper to the string with thread wound around it.

When the kite is ready to raise, lay the tail and extension straight in front and let the runner with the ball of string stand 100 feet or more distant. One boy holds the kite while another is stationed at the last bunch of crackers. When all is ready he lights the bunch, gives the order to start and the kite is raised as quickly as possible. The kite should be able to reach a height of 300 to 500 feet before the first bunch is exploded, when the fire will follow up the powder train and set off the next bunch and so on. The noise and effect of the crackers exploding as they fall from this great height is both novel and exciting. when all are fired the kite may be drawn down and again loaded.

BLOWING UP THE FORTRESS.

This exhibition may be made either with several bunches of large crackers or better, a quarter pound of powder. A shallow trench is made in the ground several inches deep, and in this a trough is laid of dry lath. This trough may be two or more laths long. In the trough lay a fuse the entire length, or a train of powder. Then cover with a lath and replace the earth, leaving one end open to fire from. At the other end connect the fuse or powder train to a quarter pound of powder in a dry tin can. The powder should be tied in thin paper, put in the can, a small opening torn in the paper so a few grains of the powder will escape, then invert the can and connect the fuse. Over the can place a small wooden box and upon the box throw carefully a light cover of earth. On the fortress set a flag and a row of round clothes pins to represent sentinels, cannon, etc. When all is ready place a piece of dry paper at the end of the fuse farthest from the mine, light it and quickly get back far enough

to avoid the explosion. When the paper burns down to the fuse or powder train, the fire will follow into the mine, and when it reaches the can of powder the fortress will fall—after first going up 25 feet in the air.

HOW FIRE CRACKERS ARE MADE IN CHINA.

Guarded Secret of the Methods of Manufacture Discovered by the American Vice-Consul.

By the Hon. John Goodnow, United States Consul-General at Shanghai, China.

In making crackers, here in China, only the cheapest kind of straw paper which can be produced in the immediate locality where the crackers are made is used for the body of the cracker. A little finer paper is used for the wrapper. A piece of straw paper 9 by 30 inches will make twenty-one crackers 1½ inches long and one-fourth of an inch in diameter.

The powder is also of the cheapest grade, and is made in the locality where used. It costs 150 to 175 per catty, or 6 to 7 cents gold per pound.

For the fuse, a paper (called "leather" in Shanghai) is used, which is imported from Japan and is made from the inner lining of the bamboo. In other places a fine rice paper is used, generally stiffened slightly with buckwheat-flour paste, which, the Chinese say, adds to its inflammability. A strip of this paper one-third of an inch wide by 14 inches (a Chinese foot) long is laid on a table, and a very little powder put down the middle of it with a hollow bamboo stick. A quick twist of the paper makes the fuse ready for use.

It is not easy to persuade the Chinese to exhibit their modes of manufacture to a foreigner; but Mr. Williams, vice-consul at Shanghai, thus describes the work as he has seen it:

The straw paper is first rolled by hand around an iron rod which varies in size according to the size of cracker to be made. To complete the rolling, a rude machine is used. This consists of two uprights supporting an axis, from which is suspended by two arms a heavy piece of wood, slightly convex on the lower side. There is just room between this swinging block and the top of the table to place the cracker. As each layer of paper is put on by hand, the cracker is placed on the table and the suspended weight is drawn over the roll, thus tightening it until no more can be passed under the weight. For the smallest "whip" crackers, the workman uses for compression, instead of this machine, a heavy piece of wood, fitted with a handle like that of a carpenter's plane. In filling crackers, two hundred to three hundred are tied together tightly in a bunch. Red clay is spread over the end of the bunch and forced into the end of each cracker with a punch. While the clay is being tamped in, a little water is sprayed on it, which makes it pack closer. The powder is poured in at the other end of the cracker. With the aid of an awl the edge of the paper is turned in at the upper end of the cracker, and the fuse is inserted through this.

The long ends of the fuses are braided together in such a way that the crackers lie in two parallel rows. The braid is doubled on itself, and a large quick-firing fuse inserted, and the whole is bound with a fine thread. The bundle is wrapped in paper and in this shape sent to the seacoast.

HOW TO MAKE A "POTASH VOLCANO."

Shooting forth flames and spouting ashes and lava the "Potash Volcano," is a minature likeness of the great Mont Pelee eruption that destroyed St. Pierre. Any child can make a "Potash Volcano," and it is not more dangerous than firing a firecracker. It is the only toy volcano that will emit lava which flows down its side in realistic streams.

To make the volcano build a mound of sand about one foot high. Dig a hole in the top five inches deep and 1½ inches in diameter. Roll up a piece of stiff paper to form a cylinder and place it in the hole making the paper form the wall of the hole. Also place a piece of stiff paper at the bottom of the hole. Make the paper hide the ground in all parts of the hole so as to keep away the moisture of the ground Now your volcano is built. The next is to load it.

You are supposed to have at your side 10 cents worth of potash, which may be bought at any drug store. Be sure to tell the druggist the purpose for which it is wanted as there are numerous kinds of potash that will not do. Mix your potash with an equal amount of sugar. Now it is ready to be put into the hole. But first arrange the fuse by which the volcano is to be lighted. For this a fire cracker stem will do, but you may make a better fuse yourself by winding powder in tissue paper. Place one end of the fuse down in the hole leaving the other end resting on the side of the volcano. Now place the mixture of potash and sugar in the hole. On top of this place a layer of pure potash unmixed with the sugar, and on this pour some gun powder. Light the fuse and the volcano will do

Home Made Volcano.

the rest. There is an explosion which sends fire, smoke and sand upward. Then follows a flame lasting for about a minute and the lava pours down the sides of the mound.

FACTS YOU OUGHT TO KNOW ABOUT OUR FLAG.

Here is some information about the American flag, furnished by Samuel Harden Church, which every American boy and girl ought to know:

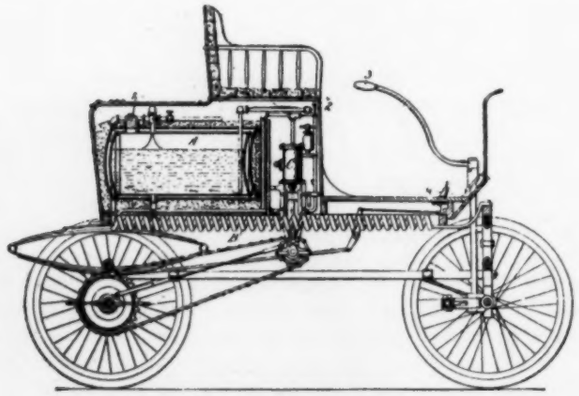
Why should the flag of such a young country be called "Old Glory"? Because it is twenty-five years older than the present flag of Great Britain, seventeen years older than the French tricolor, nearly a hundred years older than the present flag of Germany and Italy, and eight years older than the flag of Spain. When the Continental Congress found that the political bands which connected us with the mother country had indeed been perpetually broken, they appointed a committee to devise a flag that should stand for the nation; independence, dignity, and power. George Washington was the chairman of that committee, and, upon receiving his report 1777, Congress resolved, "That the flag of the thirteen United States be thirteen stripes, alternate red and white; and the union be thirteen stars, white in a blue field, representing a new constellation." At first a new star and a new stripe were added for each new state, but our vast territory was molded into states so rapidly that this arrangement became cumbersome, and in 1818 Congress passed an act returning to the original stripes, but added a

star for each new state. That is the law today, so that this flag has thirteen stripes, seven red and six white, and forty-five stars, representing a nation of seventy millions.

Immortal honor hangs thick on every square inch of its fabric. It was adopted when the American people were but a human fringe on the sea coast, their way into the interior blocked by the red savages and howling wolves of the wilderness. The whole inspiration of our life as a nation flows out from the waving folds of this banner. Our flag had its origin in that conflict whereby we achieved our independence in the last century. Again, 1812, it vindicated the principle that American seaman should not be impressed to service on foreign ships. In 1845 it again gave liberty to Texas. In 1861 it carried freedom to four million slaves in this country. It has been stormed at with shot and shell and torn to tatters in a hundred battles, but it has always waved for freedom, and after every conflict its advanced position in a better civilization has ameliorated and improved the conditions of human society. It stands now for a united people; it is beloved in every section of our territory, and when it waves aloft it's all one to us whether the band plays "Yankee Doodle" or "Dixie."

LIQUID AIR AUTOMOBILE.

At the recent automobile exhibition in London, there was seen a liquid air machine which had a speed of 20 miles an hour. The liquid air at a temperature of 312 degrees below zero, is carried in the tank A, which holds 18 gallons, or enough for



Runs with Liquid Air.

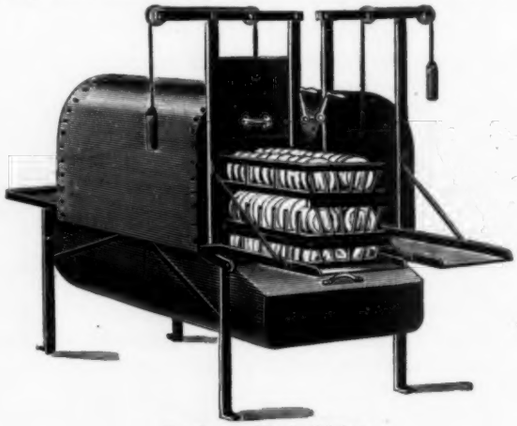
a 35-mile run. B is the radiation in which the liquid air is heated. A pressure of 200 pounds is obtained in one minute by allowing the liquid air to exaporate. Our illustration is from the Motor Car Journal, London.

SAIL THAT PULLS WITH THE SLIGHTEST BREEZE.

A novel sail has just been invented. It is composed of independent sections, each of which is separated from but overlaps the adjoining one, the result being that each section spills the wind away from the one next to it. Furthermore, the upper ends of each section are secured to a gaff and one corner of the lower end of each to a boom. Finally a pair of independent sheets or ropes are connected to the after corner of the lower end of each section and there are guiding leads for these ropes. A mainsail constructed in this fashion was tested recently and it proved much more serviceable in various respects than an old-fashioned mainsail. The main advantage claimed for this new sail, however, is said to lie in the fact that it enables a yachtsman to utilize to the utmost even a slight breeze.

DISHWASHING MACHINE, A WOMAN'S PATENT.

Dishwashing, once the abhorred drudgery of the kitchen, is made an easy, speedy and simple operation by the use of the latest improved dishwashing machine. Modern hotels and restau-



Ready to Wash Dishes.

rants throughout America have almost entirely dispensed with the old system of washing dishes by hand. Only in Europe where the people use antiquated methods because they have formed a liking for them through long association, is the machine unknown.

The standard diswashing machine of America is made by a woman, Mrs. J. Garis-Cochrane, manager, patentee and sole manufacturer of the Garis-Cochrane machines. The machinery is operated by steam or electricity and a simple device for private families is worked by hand. The dishes are placed in the

Dishes all Washed.

racks and slide directly from the scrapping table into the machine and out again. They are not lifted at all in the process of washing, rinsing and drying.

CENSUS BUREAU'S REPORT ON SHIPBUILDING.

The census bureau has issued a report on ship building and repairing in the United States in 1900. It shows a capital of $77,362,701 invested in 1,116 establishments reporting for the industry. This amount does not include the capital stock of any of the corporations. The value of the product is returned at $74,578,158. The report says:

"In 1900 the tonnage under American registry was only 826,694, showing a loss of 461,631 tons since 1890, a shrinkage double the total new registered tonnage built in the United States during the decade."

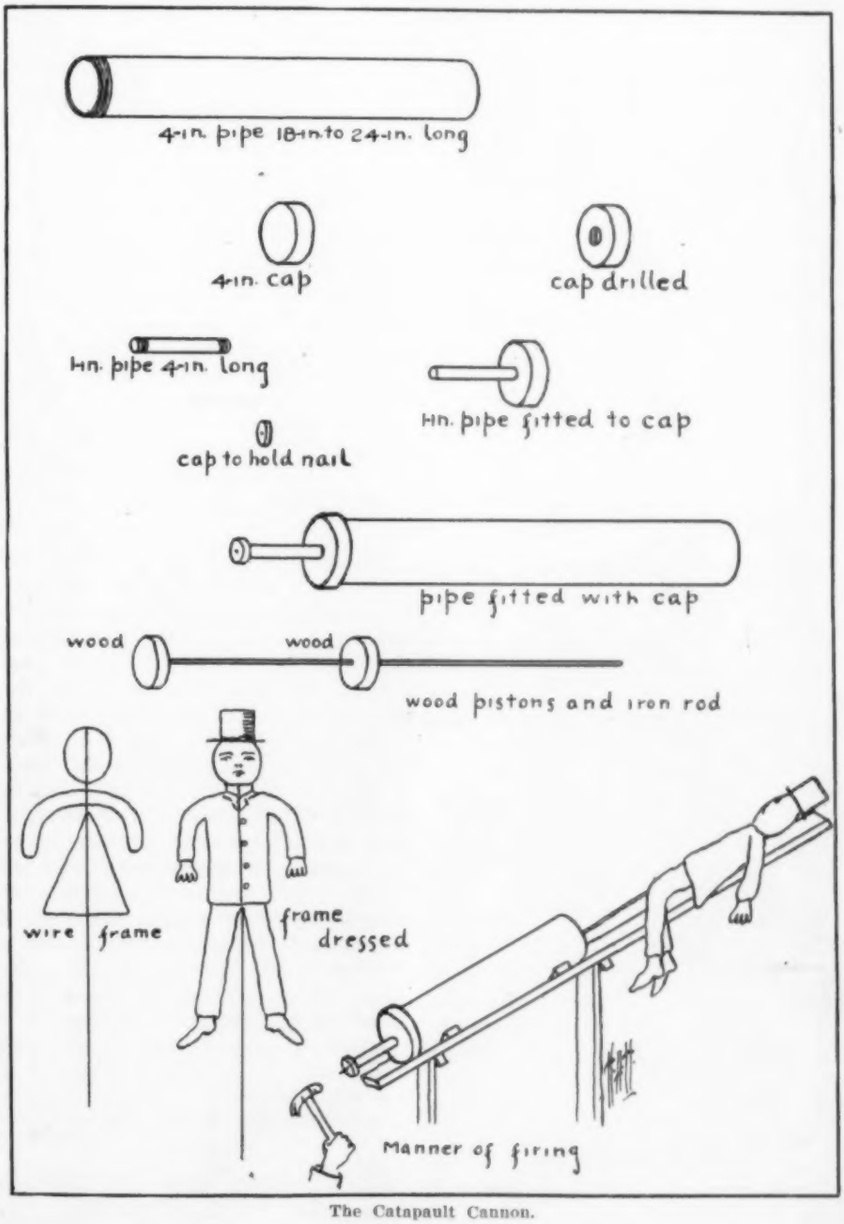
Fourth of July Catapault

Home-Made Cannon which Will Hurl Life-Size Dummy 100 Feet Through the Air

One of the most exciting amusements for boys is shooting life-sized dummies dressed as men and women from the mouth of a cannon. If care is taken to mount the cannon in the first place so it will discharge at an angle of about 45 degrees, and not to fire it when any one is within range, the first of which is easy to do and the second not difficult to remember, there is no possibility of harm. The powder charge is in the safest form possible, as it is fired with a blow from a hammer instead of a burning fuse. The outfit will afford amusement to old and young and involve no exposure or risk. If the cannon is made according to directions there cannot possibly be any explosion. Two or three days will be required to prepare the machine, so do not wait until the Fourth if you intend to have one.

First procure a piece of common steam pipe, 4 to 6 inches in diameter and anywhere from 18 to 24 inches long. Old pipe is as good as any, provided it is straight. Take it to a machinist and have him cut a thread on the outside of one end and fit an iron cap to screw on to the pipe. Then bore a hole 1 inch in diameter in the center of the cap and thread the hole. Take a piece of 1-inch gas pipe, 4 inches long, thread both ends and screw the small pipe securely into the hole in the cap. It should go in so as to project a quarter of an inch inside the cap. Then take a cap to easily screw on the outside end of the 1-inch pipe, and in the center drill a hole just large enough to permit an 6 penny wire nail to enter.

This completes the cannon proper. The next step is to make the dummy, which may be dressed in old clothes to represent either a man or woman. Two dummy frames may be made, or the dress can be changed from man to woman after the firing begins. First make two round blocks of hard pine or oak and about 3 inches thick. These blocks should be ⅛ inch less diameter than the mouth of the cannon so they will slide in and out freely. The inside of the cannon must be free from rust, and if dirty scraped clean and greased. In the center of each block bore a ¼-inch hole. Keep this hole as rough and small as possible. Next secure an iron rod about 4 feet long. Make a ring at one end and thread the other end for 4 inches. Slip one of the circular blocks onto the rod and move it up towards the ring about 14 inches. Screw a nut on the rod up 3½ inches. Slip the other circular piece of wood on the rod up against the nut, then screw on another nut to hold the wooden piston firmly in its place at the end of the rod. If the rod is flattened somewhat at the place where the upper piston is located it will hold it there. Now take some stiff iron wire about as big around as a slate pencil and make a loop at the top of the rod for the head. Wire it to the ring in the rod which is now at the top of the head. Then make the arms. This is done by lashing with a fine wire or strong hemp twine a piece of wood 1 inch square and 20 inches long; place it close to the bottom of the head. Make a triangle of the heavy wire and fasten it securely at the top of the rod to the cross arm and triangle to keep them from slipping down. The head may be made of excelsior, paper or hay put in a cloth bag of proper size and slipped on over the wire loop. Then sew the bottom of the bag, or tie it with strong string at the neck to keep the contents of the head from coming out. The head should be made of very strong material such as canvas or gunny-sack, as the head will receive plenty of punishment. A false face, or one painted on white cloth, can then be sewed on. An old coat, the lighter the better, should be put on and stuffed, allowing the arms to hang down from the shoulders. For pants a pair of old overalls are excellent. These can be



The Catapault Cannon.

stuffed or not. Tie several streamers about the waist, made of red and white bunting cut in strips 6 or 8 inches wide and several feet long. These will greatly increase the spectacular flight through the air.

To mount the cannon nail a cleat firmly across a board, put the breach of the cannon against and bind the cannon to the board with rope. Lay the board with one end on the ground and resting on two boxes or supports which will incline it at an angle of about 45 degrees. There should be just enough of the board project beyond the cannon to nicely lay the dummy on face up when the wooden pistons are put into the muzzle of the cannon. You are now ready to load. Clear away everyone in front and on either side of the cannon. As the dummy will fly from 50 to 100 feet no one must be allowed in front where they can possibly be struck with the dummy. This is important for at short range the rod on which the dummy is built will easily penetrate an ordinary tight board fence.

The firing charges consist of the ordinary shot gun paper cartridges but waded with powder only. Coarse black powder of ordinary size is best, though any size will answer. These cartridges of course are primed with percussion caps. In loading the wooden pistons (which carry the rod and dummy) into the cannon do not ram the bottom one clear back, but leave two or three inches between the cartridge and the lower piston. Insert the cartridge in the 1-inch pipe. It should fit snugly. Screw on the firing cap, insert the wire nail firing pin, until it rests against the cap in the cartridge. Then, if the range is clear, give the command to fire, which is accomplished by a sharp rap of the hammer on the nail. A loud report followed by a cloud of smoke will result and your dummy will be seen sailing through the air, the arms, legs and streamers fluttering in the air and presenting a most realistic and life-like appearance. The dummy must not be too heavy; it should weigh about 6 pounds.

To fire again, first insert the rod and pistons in the cannon, then unscrew the firing cap remove the empty shell and put in a loaded cartridge, replace the cap, insert the firing pin and you are ready for orders. A good way where there are several boys in the sport, is to choose one as captain who gives the orders; there should be two in the firing squad, one to handle the cartridges and another to screw the cap off and on and do the firing, and at least two for the hospital corps. These should have a stretcher on which to bring in the dummy after being fired.

The following definition of a lie was given by a little girl: "A lie is an abomination to the Lord and a very present help in time of trouble."

SKY LANTERNS.

These are for night display and should be flown over a vacant lot or park to avoid possibility of setting fire to housetops. Make a good sized ordinary kite, or take one of the fancy kites of a strong lifting power and to the kite string at a distance of 200 feet from the kite attach six feet of very small wire. At the end of the wire fasten a Japanese paper lantern containing a lighted candle. The small wax or paraffine candles such as are used on Christmas

Sky Lanterns in Air.

trees are best on account of weight. If the wind is strong and steady several may be attached at intervals of several hundred feet, to the kite string. Sometimes it is also possible to raise a small tea table ball at the end of the kite tail which will ring with the lashing of the tail in the wind.

NIGHT VOLCANO IN OPERATION.

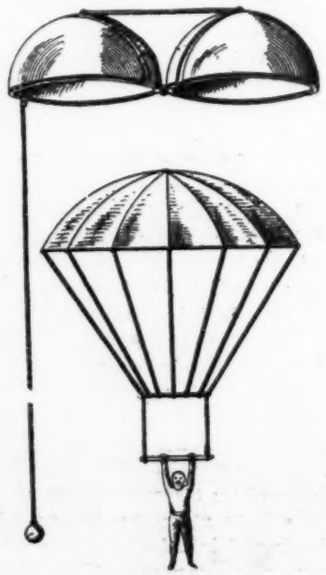
Take ordinary black powder, place it in a dish (must not be a metal one) and pour in just enough turpentine to form a dough when it is mixed. A soft pine stick of clean, new lumber free from grit, or a green branch should be used to stir the mass gently. When mixed take about as much of the powder as will fill a teacup and with the hands compress it and mould to a point at the top, the sides sloping about equally all around. In the top insert some dry twisted paper extending about two inches above the volcano. Cover the outside of the mountain with a coating of damp stiff clay (not mud) leaving an opening one-half inch across for the crater. Through this the paper extends. Light the paper with a torch and the result is a shower of beautiful sparks playing like a fountain. A volcano four inches high should burn one minute or more. It is best displayed at night, although it makes an interesting day piece.

FIRE CRACKERS THAT POP TWICE—HOW THEY ARE MADE.

In China there is a fire cracker which pops twice and which is a source of wonderful amusement to the little Chinese boys. It is called the "Twice Sounding" cracker. It has two chambers separated by a plug of clay through which runs a connecting fuse. There is also a fuse extending from the powder in the lower chamber through the side of the cracker. When the cracker is to be fired it is set on end and the fuse is lighted. The powder exploding in the chamber, throws the cracker upward, and while it is yet high in the air the second charge is exploded by fire from the fuse extending through the plug between the two chambers. In their manufacture the clay is first tampered in with a punch to form the separating plug. The lower chamber is then loaded with powder and closed by turning over the paper at the end. The upper chamber is loaded and closed with clay. A hole is punched in the side of the lower chamber with an awl and the fuse inserted through this opening.

PARACHUTE PROJECTILE.

This toy comprises a sphere in two parts hinged together and containing a miniature parachute, trapeze with figure of a man attached. A string is fastened to one of the halves of the sphere and wound



Parachute Bomb.

about it several times. The other end of the string is fastened to a small weight. The sphere is fired from a mortar, and when high in the air the string unwinds, allowing the ball to open and release the contents.

HOW TO MAKE A MATCH CANNON.

You may have a cannon in doors, which you make yourself at insignificant cost if you chance to possess a small amount of mechanical genius. Take a glass tube of one-half inch diameter and close it at one end with sealing wax. For wheels use spools and the gun carriage is made of cigar box wood. To fasten the barrel, glue a hollow piece of cork on the gun carriage as the figure shows. The wooden

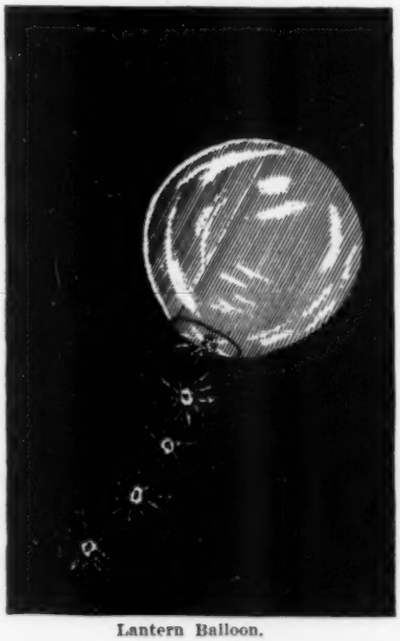
parts of the gun are connected by tacks and glue. As axle for the wheels use a strong knitting needle or a piece of wire. To prevent the wheels from coming off the axle, stick a large glass bead on each of the axle ends.

Load the gun with a parlor match, inserting it head first, and closing the opening of the barrel with a piece of cork or bread kneaded into a small ball, to make it airtight. Do not insert too tightly, or it will prevent the match from flying out.

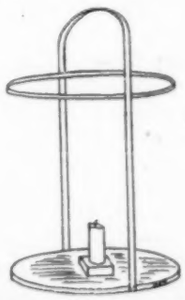
The gun is fired with a second match, held under cannon. The match will explode with the report of a miniature cannon and fly from three to five yards, enveloped in a blue cloud of smoke.

HOW TO MAKE A FOURTH OF JULY BALLOON.

To make a Fourth of July balloon first make a pattern of stiff brown papers by which to cut the gores. Of course the size of the gores depends on the size of balloon you want to make. For a balloon four feet high, there must be thirteen gores, each 6 feet long and 1 foot greatest width. Cut the gores from manila or tissue paper. The pattern should be cigar shaped, pointed at one end and flat at the other. Lay one of these gores on the floor and fold it in the center; over this lay another gore (not folded) leaving a margin of the under gore, (folded), protruding from beneath. Cover the protruding edge with paste and turn it up over the upper gore pressing it down until the edges adhere. Now fold the upper gore as you did the first one and lay a third gore on it as in the first case; paste the protruding edge, and so on until all 13 are pasted. Then it will be found that the top and bottom gores have each an edge unpasted. Lay them together and paste them neatly. Paste the bottom edge of the balloon about a hoop so as to form the mouth which will be about 16 inches in diameter. Before the hoop is fastened to the bottom of the balloon, however, it should be provided with cross wires to support the fire-ball (made of old lamp wicks wound together). Then build a fire place with a piece of stove pipe for a smoke stack. Place the wick-ball in a pan with a corked bottle of alcohol beside it. Fill the fire place with paper or shaving. Light the fire; hold the mouth of the balloon over the top of the smoke stack, not too near to ignite the paper. Let another party pour the contents of the bottle of alcohol over the wick ball in the basin. Let the ball soak up all of the spirits it will. When the balloon is extended to the utmost and is pulling, fasten the wick ball to the center of the cross wires; fasten it securely by means of twine, thread or wires, and work as rapidly as possible; touch a light to the ball and let the balloon go forth on its upward voyage.



Lantern Balloon.



Lantern Frame for Fourth of July Kite.

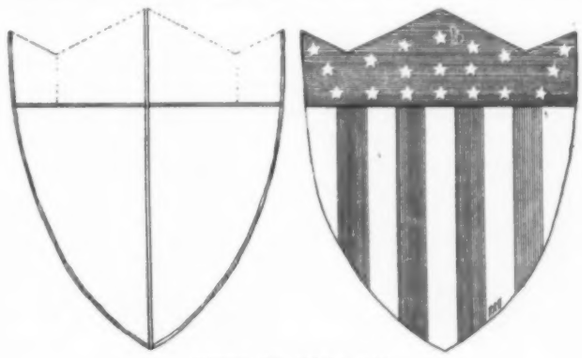
LARGEST PIE IN THE WORLD.

A feature of the coronation celebration in London will be a coronation pie on which King Edward and his lords will feast. This is to be the largest pie ever made in the world. It will weigh two tons; will be 25 feet in circumference and three feet in diameter. The mystery of its contents will be known only to the cook. Suffice it to say that it will contain "fish, flesh and good red herring."

TO MAKE A FOURTH OF JULY KITE.

Patriotic Shield That Is Easily Made and a Source of Much Sport.

The Fourth of July kite will fly in great numbers in some sections of America on the day of our independence celebration.



Frame for Shield Kite.

It is a source of great sport when properly made and trimmed. It may have a bright lantern or a string of exploding fireworks attached to its tail for night exhibitions, but in the daytime it shows up to splendid advantage without such adornment. In making the kite secure four strong sticks, two for the cross sticks and two for the curved sticks. Place the cross sticks at right angles with each other, as shown in the illustration, and fasten securely as in the case of an ordinary kite. Bend the side sticks to the curve desired and hold them in position until securely fastened. The dotted lines in Fig. 1 show how the strings should be attached.

You may be able to purchase paper with the red and white stripes already arranged as well as the star paper with the blue field. If so, you will have only two pieces to paste together. Otherwise, secure the three separate colors, red, white and blue. Paste the red and white together in stripes for the bottom. Cut out white stars and paste on the blue which forms the top. Then lay your paper cover on the floor and place your kite frame on top of it. Allow ample margin and paste on the cover as in the case of an ordinary kite.

To make the lantern cut out a round piece of pasteboard and tack it on a wooden hoop for the bottom. Then bend a thin strip of wood so that it may be attached as shown in the illustration. Cover the body of the lantern from the upper hoop to the bottom with tissue paper, leaving the top open. Melt candle to stick it at the bottom. Fastern the lantern to the tail of the kite. When in the air it will bob about in a most eccentric manner, causing wonderment to all who view it.

"Dear Editor: Our cow has gone dry, could we sell her for dride beef? If so, whear?"

Easy Electrical Experiments FOR BOYS

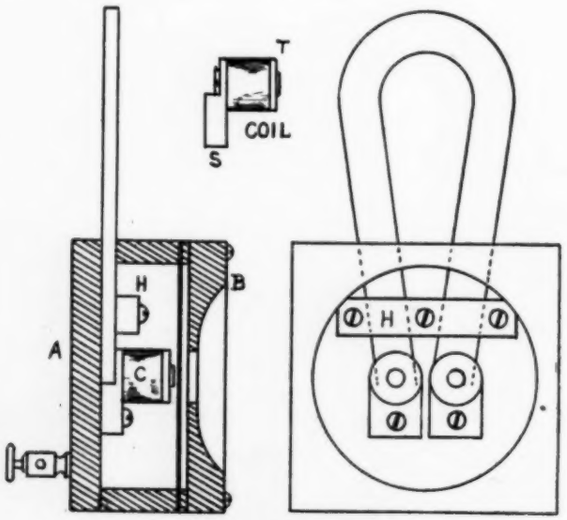
By L. P. Dickinson

CHAPTER XXV.—HOW TO MAKE A TELEPHONE.

Part II.

Having made the transmitter, we must next make the receiver. This will require the following materials: One inch horseshoe magnet, one ounce of No. 36 double silk covered magnet wire, two No. 10 flat head iron machine screws one inch long, and a few pieces of whitewood from 5/8 inch to 3/8 inch in thickness.

Cut out a piece of wood, 3½ inches square, and ½ inch thick. Draw a line through its center parallel to two edges. Lay the horseshoe magnet upon this piece, with its ends parallel to the line just drawn, and projecting ⅛ inch beyond the line. This



FRONT VIEW
DIAPHRAGM REMOVED

magnet is to be clamped firmly in place by a wooden cleat shown at H. Too much pains cannot be taken to see that the magnet is fixed so firmly in place that it will not work loose. For this reason a wooden wedge inserted between the arms of the magnet, and screwed to the backboard is desirable. Use only brass screws in this part of the apparatus.

Having clamped the magnet in place, make next a piece of wood 3½ inches square and 1¼ inches thick, with a circular hole cut out of its center 3 inches in diameter. It may be built up of two 5/8 inch pieces glued together, and the hole may be cut out by means of a scroll saw, or by the help of a small drill. This piece is to be fastened to the piece upon which the magnet is mounted, and secured firmly in place by means of glue and brads. Of course it must be cut away on the under side so as to fit over the magnet snugly, and also over the cleat which holds the magnet in place. This will make a box, square on the outside, but circular inside, with the poles of the magnet projecting through one side, and resting at the center of the box.

The coils next claim our attention. One of these is shown complete, and is also seen at C. They are made as follows: Cut out a piece of wood 1½ inches long, 3/8 inch thick, and 7/8 inch wide. Cut away one end for a distance of ¾ inch, so that it is only ⅛ inch thick. Through the center of the piece, and 7-16 inch from the thin end, bore a hole the size of the iron screws first mentioned, and push one of the bolts through the hole, from the side that is cut away. Bevel the hole on this side so that the head of the screw will sink down almost level with the surface of the strip. Make a circular wooden piece 7/8 inch in diameter, and ⅛ inch thick, with a hole through its center just big enough to fit tightly upon the screw. The strip first mentioned is to form one end of a spool of wire. The circular piece just described is to form the other end, and is accordingly screwed on to the screw after the latter is in its place in the wooden strip. These pieces are shown as S and T respectively.

The space between them is to be wound full of No. 36 double silk covered magnet wire. Before beginning to wind, cover the iron core with a layer of heavy paper, gluing it in place. Make two coils exactly alike, using the two iron screws for the purpose.

The strip S is made of the shape shown in order that the coils may be screwed to the inside of the bottom of the box, with the heads of the screws resting firmly against the poles of the steel magnet. Their position is shown in the right hand figure. Be sure that they are fastened firmly in place by means of a screw and a little glue. Then connect the terminal of one coil with one terminal of the next so that a current will go around the second coil in direction opposite to that in which it goes around the first. Connect the two remaining terminals to the two binding posts on the back of the receiver.

All that remains is to make the diaphragm and to secure it in place. It should be made from a piece of very thin ferrotype iron, such as photographers use. Cut out a circular piece 3½ inches in diameter. Cut out also a piece of wood, 3½ inches square, and 5/8 inch thick, with a hole through its center ¾ inch in diameter. Hollow out one side to form a mouthpiece as shown at B. Cut out a circular ring of heavy cardboard, whose external diameter is 3½ inches, and whose internal diameter is 3 inches.

Place the iron diaphragm over the front of the box containing the coils. It should almost touch the ends of the iron screws. Adjust it so that there will be 1-32 inch between the ends of the screws and the diaphragm. Then place the pasteboard ring on top of the diaphragm, put the wooden mouthpiece on top of this, and screw the whole together by four screws at the corners. The pasteboard ring keeps the wooden mouthpiece from touching the diaphragm except at the edges, leaving the diaphragm free to vibrate.

WHERE FIRE CRACKERS COME FROM.

Most of our best fire crackers come from China. The Chinese invented gun powder and as far back as history records fire crackers have been made and universally used in their country. In the beginning they were used to frighten away evil spirits. Now they are most generally employed on festive occasions. They are boomed at weddings, births, funerals, festivals, religious, civil and military cermonies. The very low price at which the crackers sell in China is enough to make the American boy wish he were a Chinamen on the Fourth of July. If you lived in China, you could buy two hundred fire crackers for one cent; a thousand for five cents, and a great box of 10,000 for one tael, which is equal to 62 cents. It is the duty that makes them cost so much in America. The crackers are sold at such a low cost because Chinese labor is so cheap, and because the fire crackers are made at the home of the workmen. The cracker maker works from 6 a. m. to 11 p. m., seven days a week. They are paid amounts equivalent to 5 and 7 cents a day. The women, many of whom are engaged in the work, are never paid more than 5 cents. The trade is considered unhealthful and dangerous.

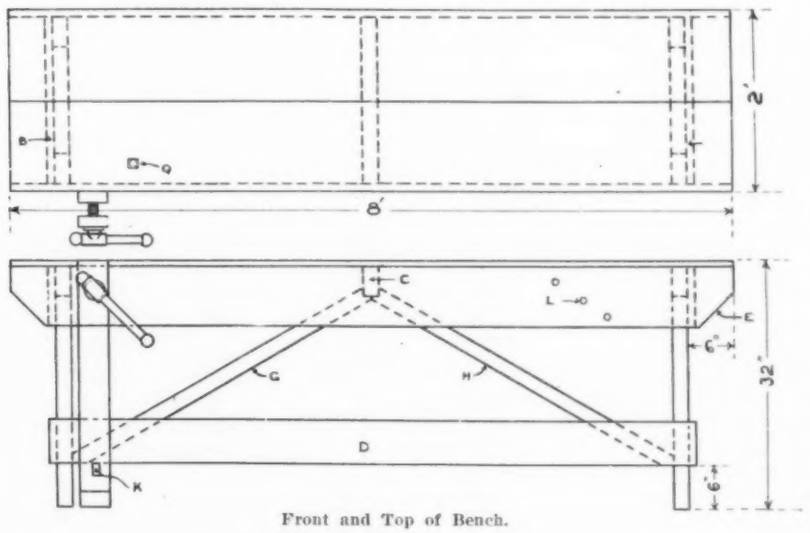
Summer Course in Easy Mechanics For Boys.

By Wilbert S. Drew.

[This series, commenced in issue of June 28, will continue each week. It will give instructions which any boy can understand, how to use carpenter's tools and make things. In doing this only a few tools will be required, and cost of material will be small. The articles to be made will include a boat, table and similar subjects.]

SELECTING TOOLS AND MAKING WORK BENCH.

In doing any kind of work requiring the use of tools, it is important that the tools and materials selected should be well adapted to the work at hand in order to secure the best results. As good work and poor tools seldom accompany each other, always buy the best your means will permit and having secured them handle them carefully and keep them in the best possible condition.



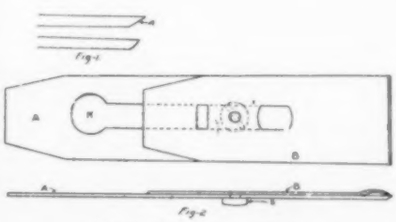
Front and Top of Bench.

It is better not to buy tools in sets, arranged in the small chests so tempting to the amateur, but select a few at a time as needed, as a better collection can be made in this way and the purchase of useless articles will be avoided.

It will be well for the beginner to select a good hand saw, rip saw, and stiff backed or tennon saw, a jack plane with iron frame, three chisels of ⅜, ⅝ and 1 inch in width, a carpenter's hammer, a try square, a two-foot rule, an oil stove of first quality, a brace and several bits, the latter running from ¼ inch to ¾ inch in diameter, and a screw driver.

One of the best oil stones for this work is that known as the India oil stone, having one side of coarse and the other side of medium grain. These cut rapidly, give a keen edge and with good care will last a lifetime.

The chisels and plane will be ground to the correct angles when purchased and they should be kept as nearly as possible of this form. In whetting them on the stone use a plentiful supply of oil, hold the tool easily but firmly in both hands with the bevelled edge on the stone and applying just sufficient pressure to cause the stone to cut nicely. The tool should be so held that the cutting edge is away from the operator and care must be used not to rock the hands up and down, as this produces a rounded edge and destroys the cutting qualities of the tool. The correct shape of the edge is shown in the upper view of Fig. 1, while the form to be avoided is shown in the lower view. After the tool has been whetted on the bevelled

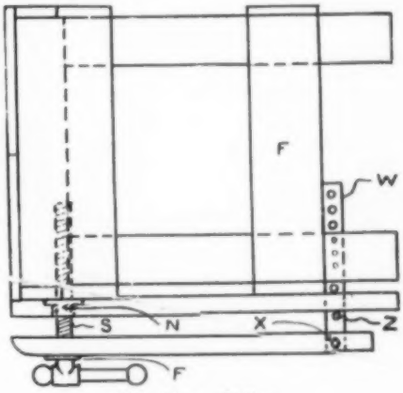


Sharpening Plane Blade.

edge A, Fig. 1, until, by running the finger along the flat side, a slight barb can be felt, the flat side should be laid on the stone and one or two movements of it made diagonally across the stone to remove this roughness. If this is properly done the tool will now be sharp enough to cut hairs from the back of the hand.

The blade of the plane, Fig. 2, is made in two pieces, the lower piece A, being the cutting part, while the upper piece, B, is a guard to prevent the wood from splintering up when planing across the grain or when the grain is crooked.

In sharpening the plane the screw S must be loosened and the piece B slid



Plan View of Vise.

back until the screw slips through the hole K, when the two parts will be separated from each other. The blade should then be treated as described above and in putting the parts together again the end of part B should be set about 1-32 inch back of the cutting edge, even with it and then the screw S must be set up tight. In doing this the clamp of the plane may be used as a screw driver.

The blade should project but a short distance beyond the bottom of the plane and must be just even with it or it will cut more on one side than on the other. In using the plane it must not be allowed to clog with chips or it will soon refuse to cut and must be taken apart and cleaned out.

To make the work bench, clear pine lumber should be used and it will be best to have it dressed at the mill. Get a sixteen-foot board 1 inch thick and 12 inches wide, another of the same length and thickness, 8 inches wide, also a piece 1 inch by 8 inches by 4 feet, a six-inch board 1 inch thick, and 16 feet long, another of same kind 4 feet long, 2 pieces 1 inch thick, 2 inches wide, 10 feet long, and a piece of 2 by 4, 16 feet long.

Cut the 12-inch board in two at the middle, giving two boards 8 feet long for the top of the bench. In cutting the pieces always draw a line at the point to be cut, using the square and a sharp knife. Saw off 4 pieces of the 2 by 4 each 27 inches long for the legs, and three pieces each 22 inches long. In cutting the 2 by 4, draw a line all around the piece with knife and square and saw exactly to the line with the stiff-backed saw.

Place one of the 22-inch lengths on top of each pair of legs and nail securely. Now cut the 8-inch board in the middle, shape ends as shown at E in the drawing and

nail in the position shown, setting the legs back 6 inches from each end. Take the 8-inch by 4 foot board and cut two lengths each 22 inches long and nail on ends as shown at A and B. Now nail in brace C, using three nails in each end. The nails should be about 2½ inches long. Cut the pieces D and F, from the 6-inch boards, 7 feet 2 inches long, and 22 inches long, respectively, and nail in position as shown, 6 inches above the floor. Next put in braces G and H and lastly nail on the top. Nail well into each cross piece and also into the side pieces.

This completes the bench and we are now ready to make the vise.

For this get two pieces of well-seasoned white oak, 1½ inches thick, 4 to 6 inches wide, one of them 32 inches long and the other 30 inches long, and a strip of oak 1 inch by 1½ inches by 18 inches.

The screw and fittings can be bought of your hardware dealer. These fittings consist of the screw, S, a nut N and flange F.

Bore a hole in the back piece of the vise, four inches from the top and fit the nut into it snugly. The flange or rim of the nut must go on the back side of the piece to keep it from pulling through. Bore a hole in the front, or shorter piece of the vise in same position as the other hole just made and of such a size as to allow the screw to just slip through.

Cut the hole K in position shown in the front piece by boring two holes close together with a ¾-inch bit and chisel out to size, 1 inch by 1½ inch. Fit the remaining strip into this hole, making a good snug joint and cut another hole in the back piece in a corresponding position so that the strip W will just slide through nicely. Now fasten the strip into the front piece by boring a ⅜-inch hole X and driving in a hardwood pin. Bore a row of ⅜-inch holes, 1½ inches apart in strip W. Screw the back piece of vise firmly in position shown, screw the flange F in position, and pass the screw through the nut. Make a pin Z to fit the ⅜-inch hole.

In using the vise this pin is slipped into the proper hole in front of the back piece of the vise in order to keep the jaws parallel with each other when tightened on the work. A hole must also be bored in the front side piece of the bench to let the screw pass through.

An adjustable bench stop should be purchased and put in position as indicated at Q. This is to hold the end of a board which is rested against it when planing its sides.

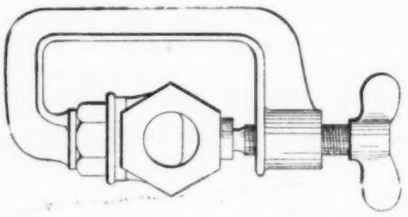
The ⅜-inch hole L should be bored for receiving a pin to support long boards when the edges are being planed.

The summer course is by Prof. Drew of the Chicago Manual Training School, one of the leading institutions of its kind in the world.

SHOP NOTES

SECURING WORN-OUT CAP OF CHECK VALVE.

An excellent temporary repair of a check valve with worn-out cap is given in



the Engineer and illustrated herewith. The cut explains itself.

HOW HOLLOW SHAFTS ARE FORGED.

By H. F. P. Porter, of the Bethlehem Steel Co.

There are two ways of making a forging hollow. The ordinary way of getting rid of the center of a forging is simply to bore it out. After boring, it is tempered, and thus the strength is restored which was taken away with the material which was in the center.

Another way of getting rid of the center of large forgings is to forge them hollow. A person who has not considered the subject carefully would naturally think that the first thing to do in making a hollow forging would be to cast a hollow ingot. It has been mentioned that there are various defects which occur in ingots, the most serious of which are "segregation" and "piping," and that it is in the center and upper portion where those defects occur. If an ingot were to be cast hollow a solid core of fire-brick or similar material would replace the center metal, and instead of one on the outside there would be two cooling surfaces, one on the outside and one around the core, and the position of last cooling would be transferred to an annular ring midway between these surfaces where the "piping" and the "segregation" would collect. This would not be satisfactory, because the metal there is what must be depended upon for the strength of the hollow forging. It is necessary, therefore, to collect the "piping" and "segregation" in the center and at the top, where metal has been added to the original ingot for the purpose.

Then, having cut off the top and bored out the center, the "piping" and "segregation" are entirely eliminated, and what is left is as sound and homogeneous a piece of steel as can be obtained.

After the hole has been bored in the ingot, the next process is to reheat it, and, as before explained, this process is not as delicate a one as if the ingot were solid. The heat affects the center equally with the exterior and the two expand together and the danger of cracking is not incurred. When the ingot is reheated a steel mandrel is put through its hollow center, and subjecting the two to hydraulic pressure, the metal is forced down and out over the mandrel. Thus an internal anvil is practically inserted into the forging and there is, therefore, really much less than one-half the amount of metal to work on than if the piece were solid.

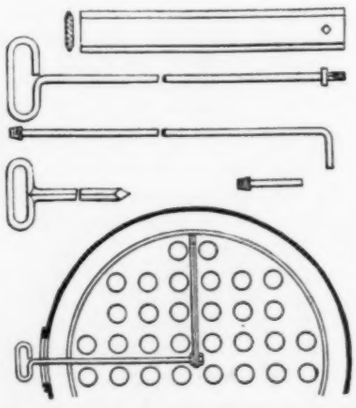
When the work of shaping is completed the forging is reheated to the proper temperature and then either annealed in the usual manner or plunged into a tempering bath of oil or brine, to set the fine grain permanently that has been established by the reheating. A mild annealing follows to relieve any surface or other strains that may have been occasioned by the rapid cooling.

Hollow forgings oil tempered and annealed are considered the best grade of forgings made and any forgings made otherwise, although they may be suitable for the service to which they may be applied, cannot be looked upon in any other manner than as of an inferior grade.

REMOVES SCALE FROM BETWEEN TUBES.

A simple device for removing scale from between tubes of upright boilers has been made and successfully used by John M. Leitch. In the Engineer he says:

"The clipper smashes all the scale collected between the tubes and the straight



and angle hose-pipe washes it out, cleaning the pipe down to the bare iron. The crown of the tube sheet of any boiler is a vital spot. It is dangerous to have scale there as the sheet is liable to get overheated and weakened and then comes what is called a 'mysterious explosion.'"

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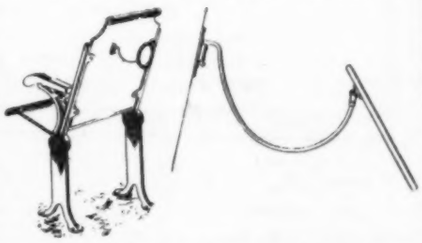
WOULD REARRANGE THE AMERICAN FLAG.

Representative Shafroth of Colorado suggests a plan for changing the arrangement of the American flag. He would have the field of the flag one-third the fly length of the banner and contain thirteen stars in a circle, representing the thirteen original states. He would then have thirty stars, representing thirty states, placed within the circle in the design of a large star, and two stars, representing Wyoming, Utah and Hawaii, the last states admitted to the Union, placed temporarily on a straight line each side of the center of the interior star. His plan is to continue the symmetry of the design as other states are admitted. He thinks the stars representing the thirteen original states should be one-eighth larger than those representing the states afterward admitted.

MIRROR FOR THEATER CHAIRS.

Hattie A. Northridge of Brooklyn, N. Y., went to a theater and mussed her hair all up in removing her bonnet. By the time she reached home she had invented a mirror attachment which she says should be on the back of every seat in a theater. When not in use it can be swung out of the way. It also affords a ready means of looking at the people behind one without twisting your neck out of joint.



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Attractions for Next Week.

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A Canadian statesman a short time ago said that if Canada had thrown off the British yoke at the same time as the United States did, Canada would now be equally populous and prosperous. He thought Canada would always be of humiliating importance unless she united her fortunes with Uncle Sam. Uncle Sam is something of a Mormon, you know, and if Canada does not wait until she is a withered up old maid, bereft of all her charms, our Uncle Sam may receive her in his fold and let her partake of our overflowing bounty. The English somehow are so far behind. They have just now begun to make general use of celluloid. They didn't know it would burn. One Englisman had his neck burned from wearing a celluloid collar; an English lady's comb caught fire and burned her hair; an organ with celluloid keys exploded—read about it next week.

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